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Addressing JCIDS Capability and Solution Analysis: An AoA Manual for Materiel and Non-materiel Information Technology Activities

Kevan Barton

Charles Sinex

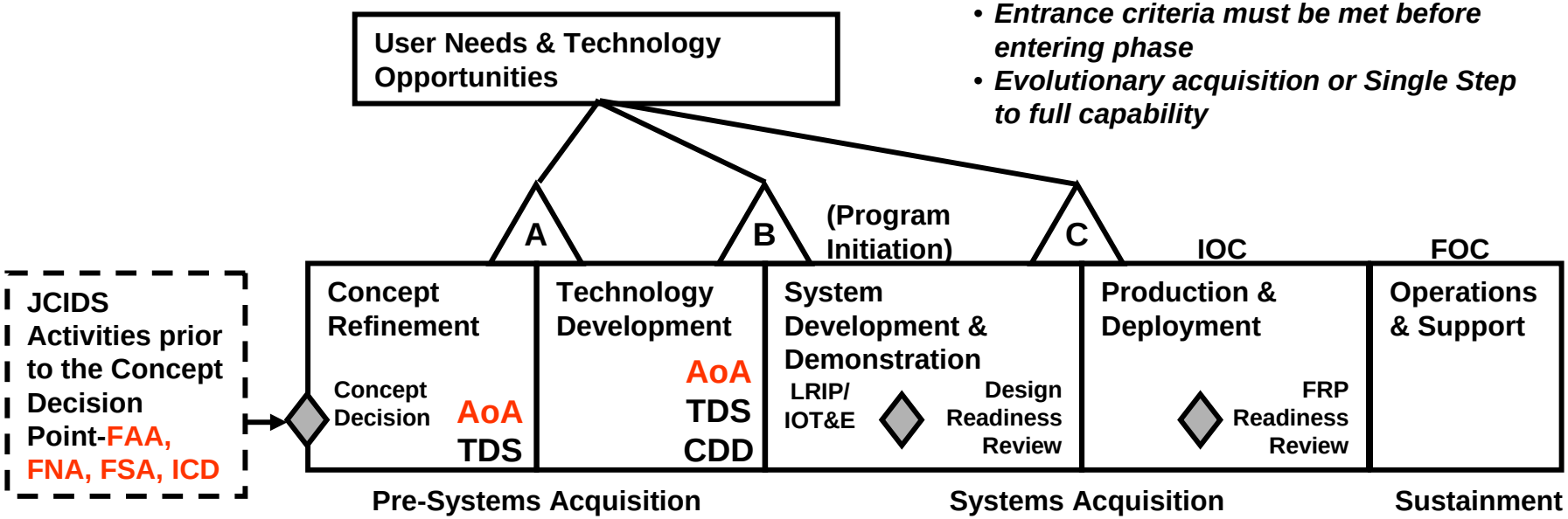
21-23 June 2005

Why an AoA Manual?
Shortcomings of Existing Guidance

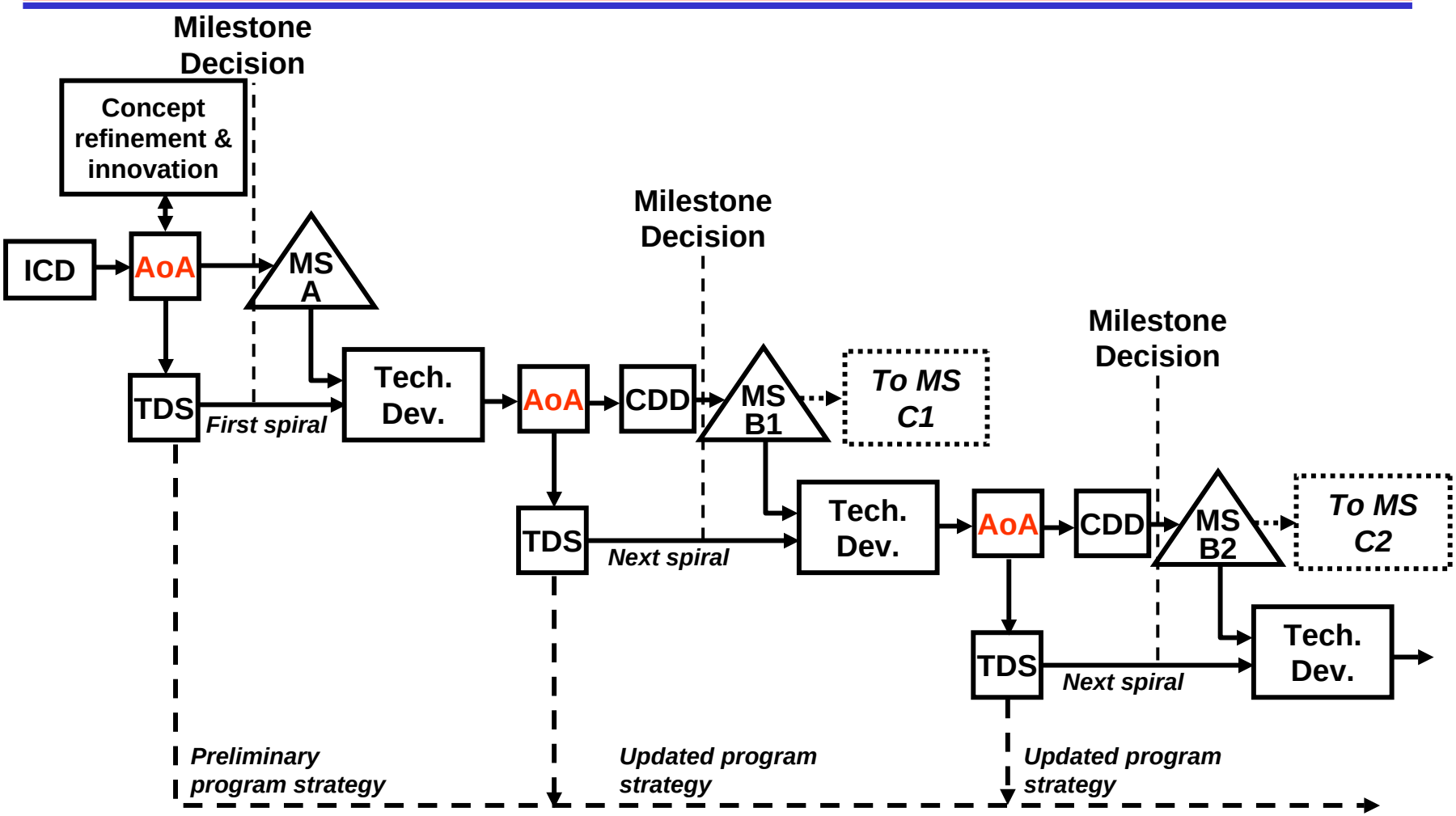
- **Focus on AoAs in the pre-JCIDS environment**
- **Focus on quantitative comparison of detailed designs, not qualitative comparison of conceptual designs**
- **Focus on platform and weapon systems rather than Information Systems and processes**
- **Limited guidance on concept and capability refinement**
- **Limited guidance on specific tools and techniques**

Acquisition Framework
Early Concept Decision & Refinement

- *Process entry at Milestones A, B or C*
- *Entrance criteria must be met before entering phase*
- *Evolutionary acquisition or Single Step to full capability*



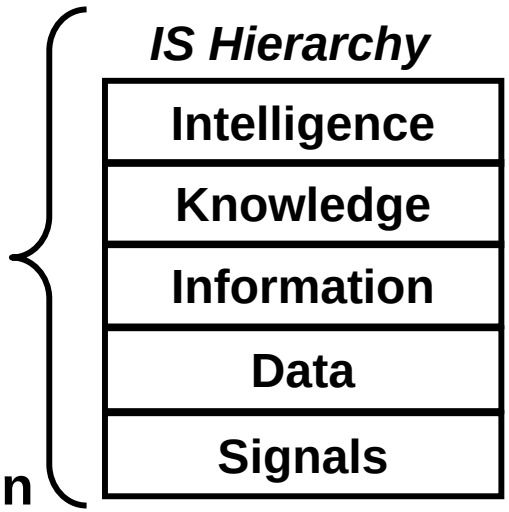
AoAs in Spiral Development
Not a One-Time Event



TDS -- Technology Development Strategy*

Information Systems (IS) Different from Platform/Weapons

- **ISs are primarily concerned with handling and/or processing of information**
- **A major goal of many ISs is to increase the value of information by the application of appropriate processes---e.g., to move from signals to intelligence**
- **ISs can often be modeled as a process model-- a sequence of human and/or computer-controlled steps in the information processing chain**
- **Compared to major weapon systems, ISs generally:**
  - ***Follow a rapid technology cycle (1-3 years)***
  - ***Are frequently upgraded, even during design***
  - ***Have shorter lifetime before replacement***



What Must the AoA Address?
Six Specific Topics

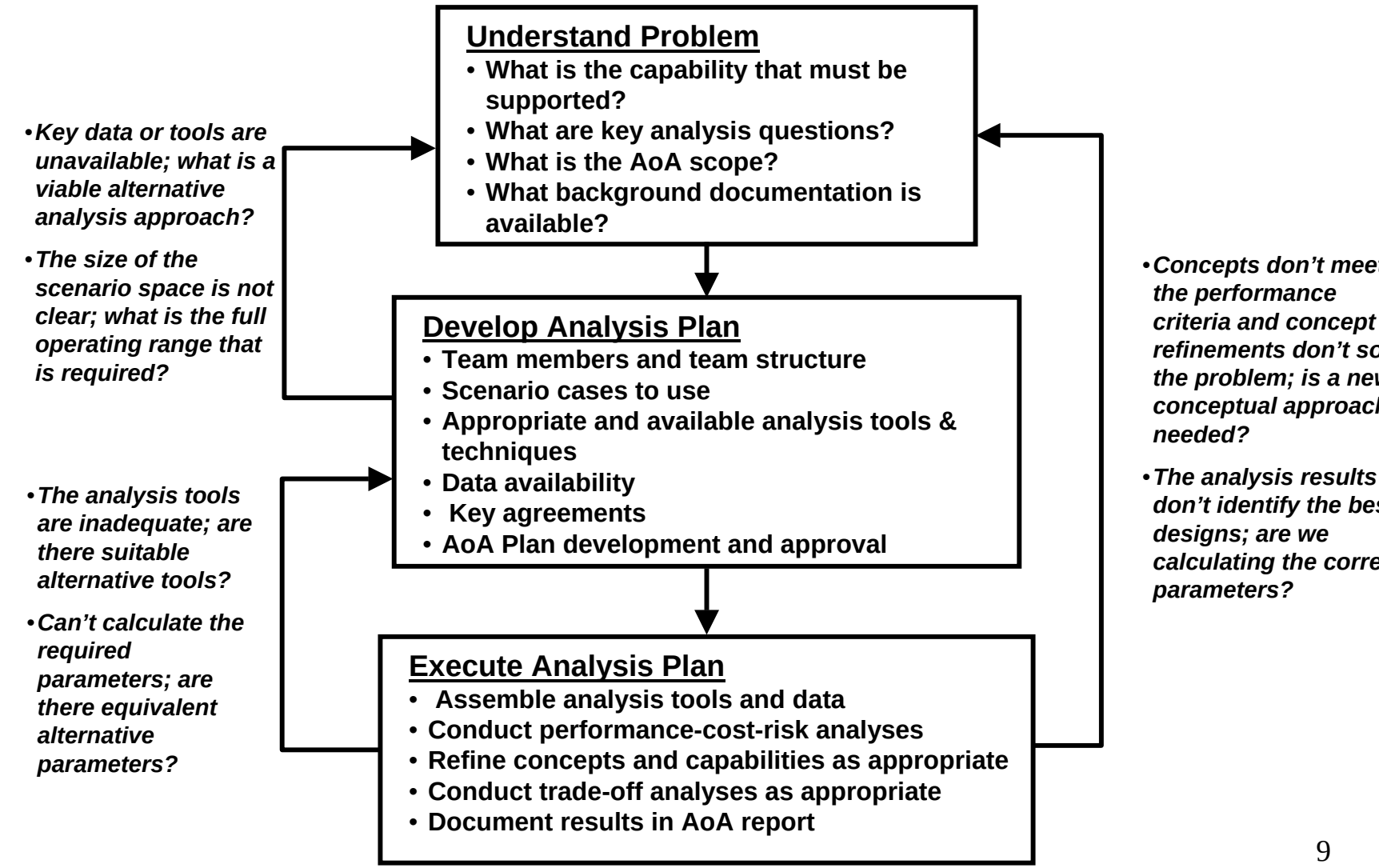
- **The AoA plan and analysis should address the specific topics highlighted by DoD 5000.2 for PA&E assessment of the AoA:**
  - ***Illuminated capability advantages and disadvantages***
  - ***Considered joint operational plans***
  - ***Examined sufficient feasible alternatives***
  - ***Discussed key assumptions and variables and sensitivity to changes in these***
  - ***Assessed technology risk and maturity***
  - ***Calculated costs***
- **The AoA also provides the basis for the Technology Development Strategy (TDS) document**

AoA Manual Outline (13 chapters-- ≈175 pages)

1. Introduction
2. Defense System Acquisition Framework (JCIDS Overview)
3. AoA Methodology
4. AoA Study Plan
5. Preparing for Analysis
6. AoA Analysis Strategy
7. Capabilities Refinement
8. Concept Refinement
9. Performance Analysis
10. Cost Analysis
11. Technology Risk Analysis
12. Performance-Cost-Risk Tradeoffs
13. Final Results

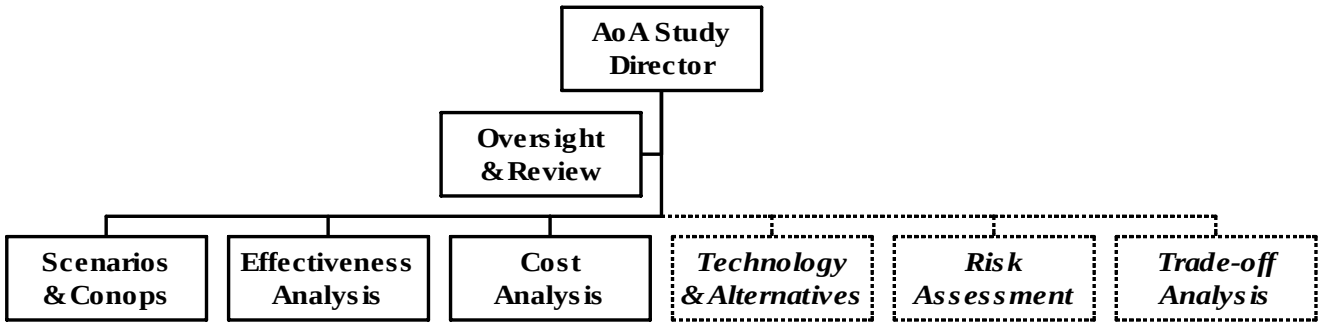
Six Appendices (including examples of analysis techniques)

AoA Methodology (Chapter 3)
An Iterative Process

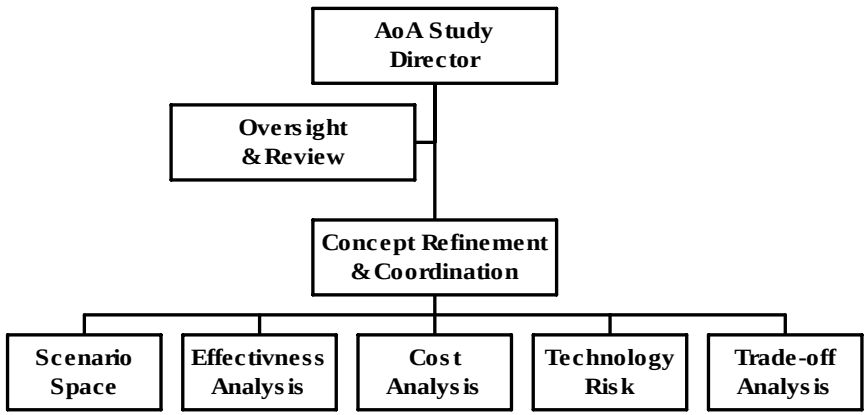


AoA Team Structure (Chapter 5)
No Universal Style

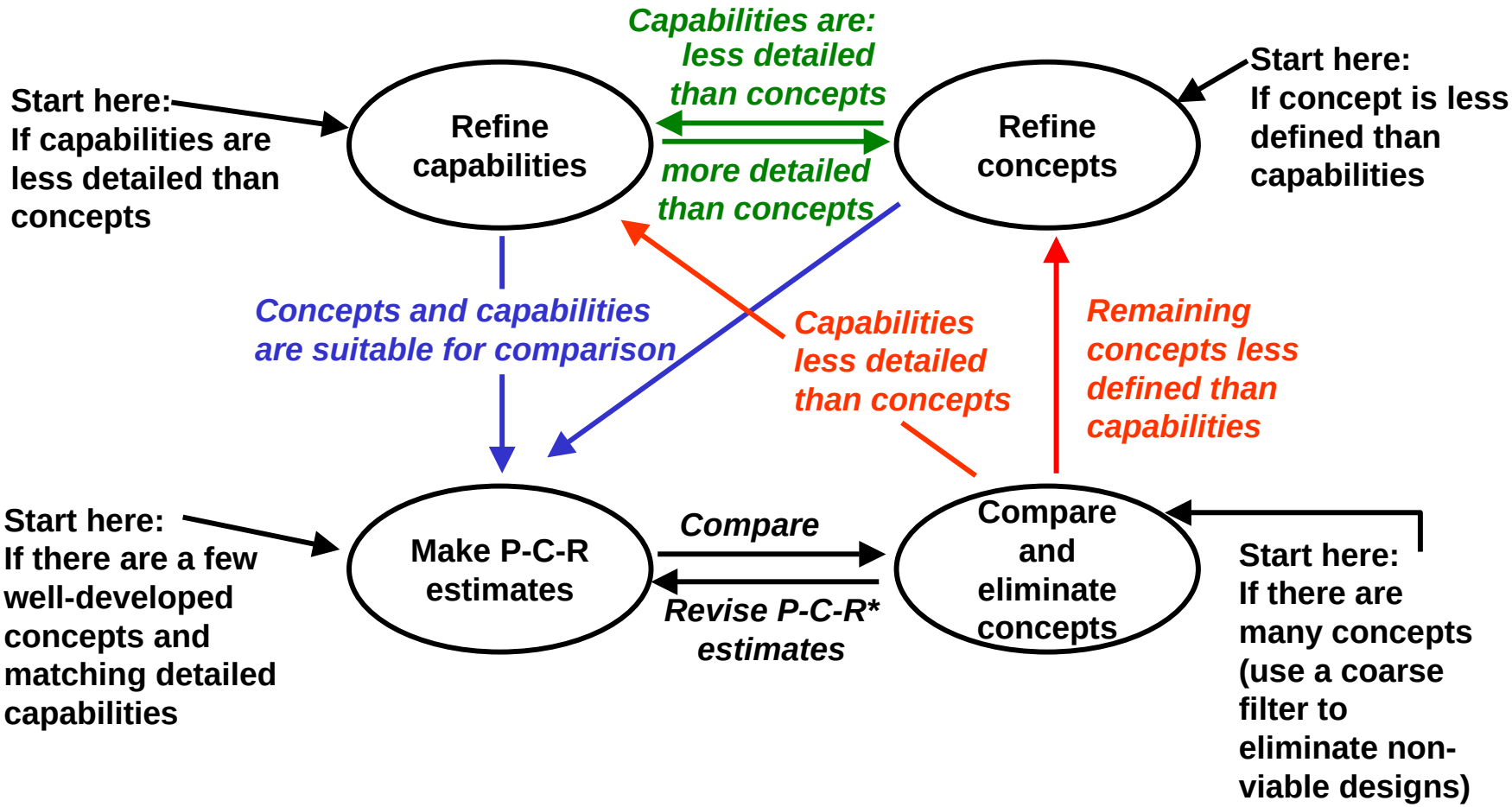
"Conventional" AoA Team Structure



Candidate Team Structure for Initial AoA in JCIDS



Analysis Strategy (Chapter 6)
How to Move between Tasks



* P-C-R: Performance-Cost-Risk

Candidate Tools and Techniques
Where They Work

Tools & Techniques	Concept Refinement	Capability Refinement	P-C-R Calculations	Trade-off Analysis
Subject Matter Experts	X	X	X	X
ATAM	X		P, R	
Analysis by Analogy			P, C, R	
QAM	X		P, R	
M&S			P, R	
Hierarchical Structures	X	X		
QFD	X	X		
TRIZ	X			

Candidate Tools and Techniques
Where They Work (cont.)

Tools & Techniques	Concept Refinement	Capability Refinement	P-C-R Calculations	Trade-off Analysis
MADT- VFT				X
MADT-AHP				X
Technology Readiness Level (TRL)			R	
Technology S-curves	X		R	
Fast Heuristics				X
Parametric Costing			C	
Engineering Costing			C	
Cost Sufficiency			C	

Summary

- **AoAs have changed significantly under JCIDS with a broader range of roles and activities for the AoA team:**
  - ***Capability refinement***
  - ***Concept refinement***
  - ***Performance-Cost-Technology Risk Assessments***
  - ***Trade-off analysis***
- **AoAs before Milestone A frequently may not have quantitative metrics**
- **The AoA is not a one-time event; it is reviewed and revised or redone in spiral development**
- **A number of analysis tools are available for the AoA that work well with qualitative metrics**
- **The new Manual provides specific guidance for conducting AoAs in this new environment**

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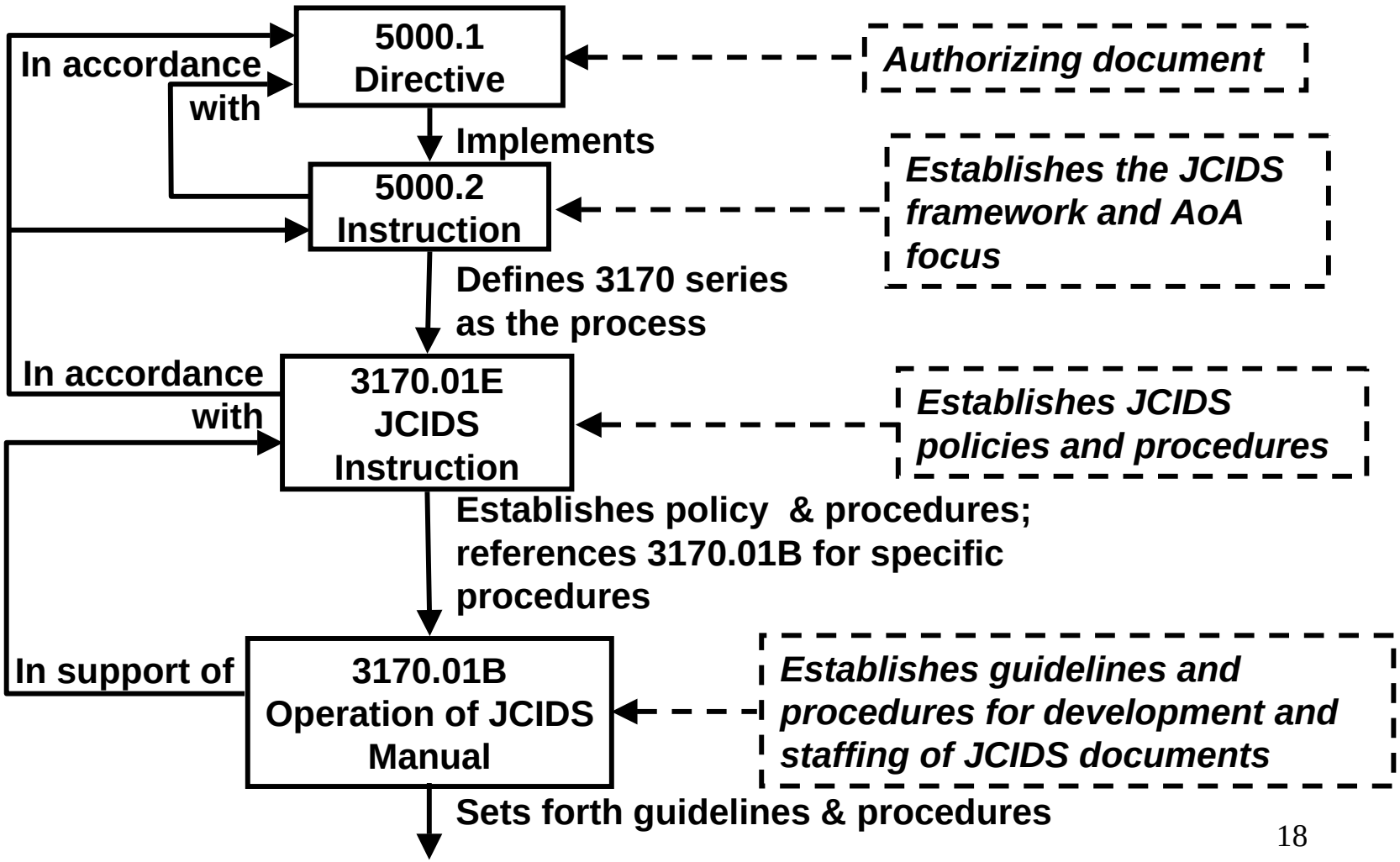
Back-up slides

Issues with DoD Acquisition
Why JCIDS?

- **Need to plan for future uncertainty**
  - ***JCIDS adopts Capability Based Planning***
- **Very long product development times**
  - ***JCIDS adopts Evolutionary Acquisition w/ Spiral Development as the preferred strategy***
- **Stove-piped planning**
  - ***JCIDS is top-down driven from a Joint perspective***
- **Emphasis on process rather than product**
  - ***JCIDS promotes flexibility subject to compliance with statutory and regulatory requirements***
- **Difficulty in introducing "novel, innovative" systems**
  - ***AoA must consider alternative, novel concepts and help define a pre-acquisition decision Technology Development effort***

The Defining JCIDS Documents
A Sequence of Four



Capabilities Based Planning
What is it in JCIDS?

- **Capabilities definition (3170)**
  - ***"The ability to execute a specified course of action. It is defined by an operational user and expressed in broad operational terms in the format of an initial capabilities document or a DOTMLPF recommendation. In the case of material proposals, the definition will progressively evolve to DOTMLPF performance attributes identified in the CDD and the CPD"***
- **Attributes definition (3170)**
  - ***"A testable or measurable characteristic that describes an aspect of a system or capability"***
- **Metrics definition (based on general community usage)**
  - ***Quantifiable parameters that show to what extent attributes are achieved by a particular system***
  - ***Metrics have three elements***
    - **A clear description of the parameter being measured**
    - **A testable and measurable value for its threshold**
    - **A testable and measurable value for its objective**

Where They are Specified

Functional Area Analysis

"The FAA includes capability-based analysis in identifying the operational tasks, conditions, and standards."

Functional Needs Analysis

"Describe the key attributes… This description should address the elements of time, distance, effect…. Identify JROC approved functional area metrics… If integrated architectures do not yet exist…. propose appropriate metrics."

Initial Capabilities Document

"Capability definitions must contain the required attributes with appropriate measures of effectiveness, e.g., time, distance, effect (including scale)…"

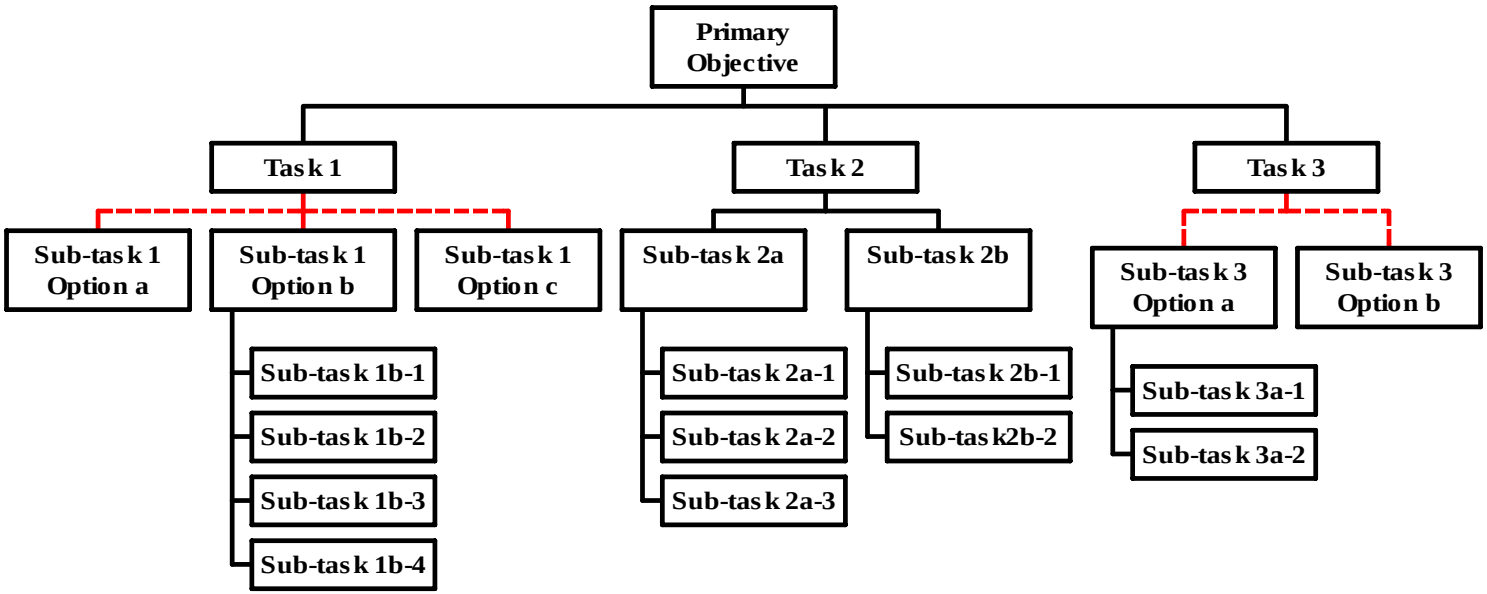
Capabilities Development Document

"Present each attribute in an output-oriented, measurable and testable terms. For each attribute, provide a threshold and objective value."

The text for these activities suggests capabilities described by quantitative metrics are desirable, but nothing mandates it.

Attributes MUST be measurable and testable, preferably with quantitative values; MOEs are qualitative or quantitative measures…

Generic Hierarchical Task Structure

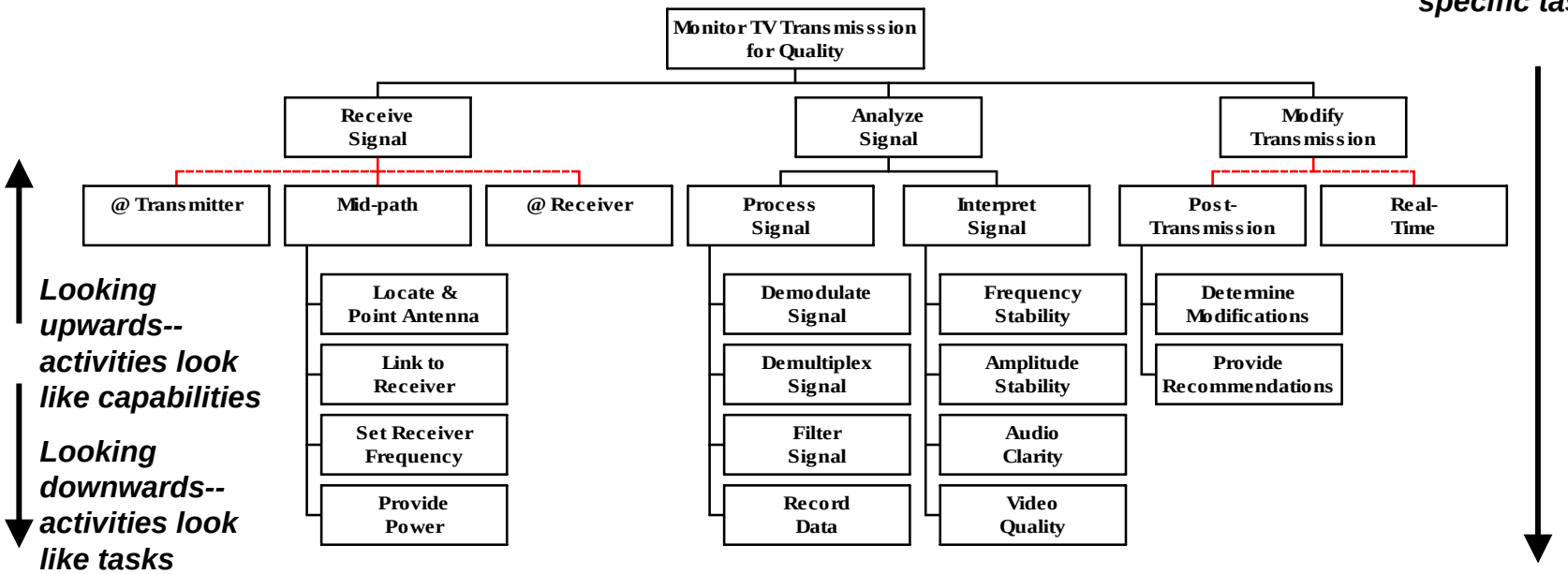


All tasks are required (logical AND)

Any combination of tasks is acceptable (logical OR)

Hierarchical Structure Example
Concept or Capability Refinement

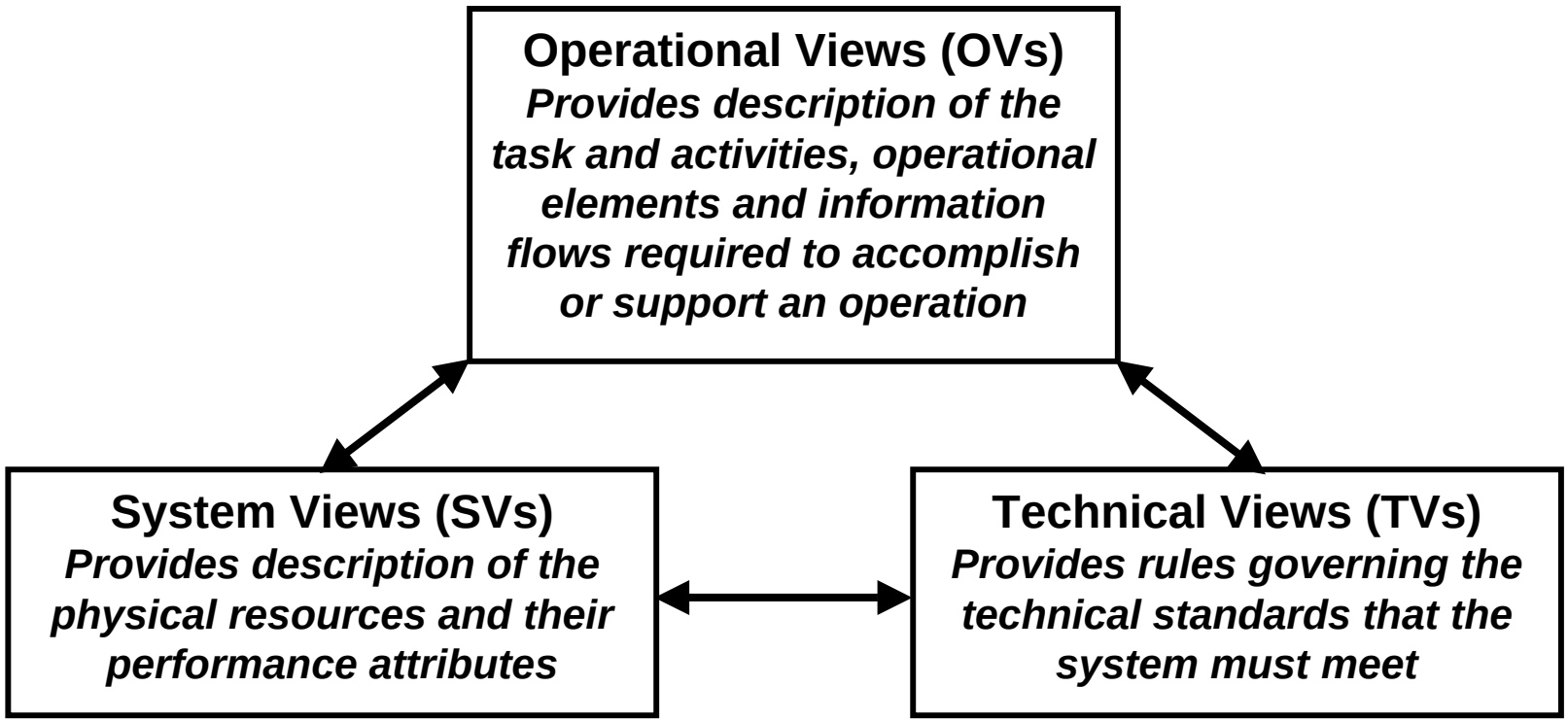
"Refining" capabilities inevitably narrows the solution space and eventually leads to specific tasks



All tasks are required (AND)

Any combination of tasks is acceptable (OR)

Architecture Framework
Required Description for New Systems



Notional OV-5 Activity Diagram
Key View for IT System Analysis